TRANSMITTAL OF APPEAL BRIEF (Large Entity)	Docket No. 3804

In Re Application Of: **LANG, T.**

Application No.	Filing Date	Examiner	Customer No.	Group Art Unit	Confirmation No.
10/591,897	09/07/2006	WEST, J.	278	3804	6440

Invention: **DETERMINATION OF A RECEPTION TIME...**

COMMISSIONER FOR PATENTS:

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MICHAEL J. STRIKER
ATTORNEY FOR THE APPLICANT
REG. NO.: 27233

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United States Patent and Trademark Office

Examiner: West, J . | Art Unit: 2857 | Docket No. 3804

In re:

Applicant: Tobias Lang

Serial No.: 10/591,897

Filed: September 7, 2006

APPEAL BRIEF

May 24, 2010

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Sirs:

Appellant submits the following for his brief on appeal and respectfully requests withdrawal of the outstanding rejections and placement of the application in line for allowance in consideration of same.

I. REAL PARTY IN INTEREST

The real party in interest in the instant application is the assignee of the application, Robert Bosch GmbH, Stuttgart, Germany.

II. RELATED APPEALS AND INTERFERENCES

Appellant is unaware of any related appeals or interferences with regard to the application.

III. STATUS OF CLAIMS

Claims 1 and 4-7 are rejected, of which claims 1 and 7 are the independent claims. Claims 2, 3, 8 and 9 were canceled. Claims 1 and 4-7 are appealed.

IV. STATUS OF AMENDMENTS

A final Office Action was mailed on November 27, 2009, objecting to claim 7, rejecting claims 1 and 4-7 under 35 USC §112, second paragraph, finally rejecting claims 1, 4, 6 and 7 under 35 USC §103(a) as unpatentable over Japanese Patent Application Pub. No. 2003-050145 to Eshita, et al. (Eshita) in view of US Patent No. 5,633,715 to Ai, et al. (Ai), and finally rejecting claims 1 and 4-7 under §103(a) as unpatentable over applicant's admitted prior art (AAPA) in view of Eshita further in view of Ai

A Request for Reconsideration was submitted on January 27, 2010, which amended claim 7, presenting arguments directed to overcoming the final

rejection of claims 1 and 4-7 under §112, second paragraph and presenting arguments directed to overcoming the final rejection of claims 1 and 4-7 under §103(a) over Eshita in view of Ai, and over AAPA in view of Eshita further in view of Ai.

An Advisory Action was mailed on February 17, 2010, which maintained the final rejection of claims 1 and 4-7 under §112, second paragraph, of claims 1, 4, 6 and 7 under §103(a) over Eshita in view of Ai, and of claims 1 and 4-7 over AAPA in view of Eshita further in view of Ai.

An Examiner Interview between Examiner West and Appellants' representative Ely Zborovsky was conducted on February 23, 2010, during which the subject matter of the independent claims was discussed in view of Eshita. No agreement was reached and no change in status of the claims as "finally rejected" was made.

Appellant filed his Notice of Appeal on March 24, 2010.

V. <u>SUMMARY OF CLAIMED SUBJECT MATTER</u>

1. An ultrasonic flow sensor **(Fig. 2)**, comprising

at least one ultrasonic transducer **(Fig. 2, ultrasonic transducers A and B)** for transmitting and receiving ultrasonic signals **(A0, B0; page 2, lines 1-6)**, and

a receiver unit (4) **(Fig. 2)** connected to the at least one ultrasonic transducer that detects a predetermined event (N) of an ultrasonic signal as a reception time (t_0) **(Figs. 3 and 4; page 6, lines 12-15)**,

wherein the receiver unit (4) determines a time (t_1) of a characteristic value of the ultrasonic signal **(page 6, lines 17-21; Figs. 3 and 4; page 3, lines 20-25)** as well as a time shift (Δt) of the time (t_1) relative to the reception time (t_0) and

uses the time shift (Δt) to determine a correct time value for the reception time (t_0) **(page 6, lines 25-27; page 3, line 25-page 4, line 3)**,

wherein the receiver unit (4) determines a chronological position (T_s) of a focal point of either the ultrasonic signal or its envelope curve (6) as the characteristic value **(Fig. 6, page 7, lines 23-29; Fig. 7; page 8, lines 5-9)**, wherein

$$Ts \sim \left(\sum_{K=1}^{n} K * A(K) \right) / \sum_{K=1}^{n} A(K) .$$

7. A method for detection of an ultrasonic signal in an ultrasonic transducer **(Fig. 2, ultrasonic transducers A and B; page 5, lines 1-6)** by means of a receiver unit (4) **(Fig. 2)**, which detects a predetermined event (N) of the ultrasonic signal as a reception time (t_0) **(Figs. 3 and 4; page 6, lines 12-15)**,

wherein the receiver unit (4) determines a time (t_1) of a characteristic value of the ultrasonic signal **(page 6, lines 17-21; Figs. 3 and 4; page 3, lines 20-25)** and determines a time shift (Δt) of the time (t_1) in relation to the reception time (t_0) and uses the time shift (Δt) to determine a correct time value for the reception time (t_0) **(page 6, lines 25-29; page 3, line 25-page 4, line 2)**,

wherein the receiver unit (4) determines a chronological position (T_s) of a focal point of the ultrasonic signal or its envelope curve (6) as the characteristic value **(Fig. 6; page 7, lines 23-29; Fig. 7, page 8, lines 5-9)**, wherein

$$Ts \sim \left(\sum_{K=1}^{n} K * A(K)\right) / \sum_{K=1}^{n} A(K) \quad .$$

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether claims 1 and 4-7 are indefinite under 35 U.S.C. §112, second paragraph for use of two (2) variables (K, A).

2. Whether claims 1, 4, 6 and 7 under 35 USC §103(a) are unpatentable over Japanese Patent Application Pub. No. 2003-050145 to Eshita, et al. (Eshita) in view of US Patent No. 5,633,715 to Ai, et al. (Ai).

3. Whether claims 1 and 4-7 are unpatentable under §103(a) over applicant's admitted prior art (AAPA) in view of Eshita further in view of Ai.

VII. ARGUMENT

1. The use of variables "K" and "A" in claims 1 and 4-7 does not render the claims unclear to the skilled artisan, and therefore indefinite under §112, second paragraph.

Appellant's invention provides for accurately determining a time (t_0) of a first zero crossing of a pulsed ultrasonic signal that exceeds a threshold SW (see Figs. 3, 4 and 6), even where there is a fluctuation in signal strength (amplitude). If a detection error occurs, the invention detects the error state, and makes a correction.

In prior art systems and methods that define signal reception by detecting a first zero crossing after a certain amplitude (e.g., SW) is detected, error can occur where the received signal somehow is smaller or larger than expected.

Fig. 4 depicts a case of reduced amplitude AMP in which the received ultrasonic signal could exceed SW at a later, erroneous time N_1. In such case, the total time is off by one period (T), or 1/f of the frequency of the signal comprising the pulse.

The invention as claimed overcomes such error. It does so by measuring a time (t_1) of a characteristic value of the ultrasound signal, i.e., a time of maximum amplitude, time of the signal focal point or time of the envelope curve focal point (see Figs. 3, 4 and 6), and then calculating a time shift between the reception time and the time of the characteristic value and using the time shift to verify the accuracy of the detection time. The invention as claimed determines and utilizes the chronological focal point T_s, which is the equation at issue in the final rejection under §112, second paragraph.

The equation T_s includes a counter "K" and a function, A(K). A(K) is the amplitude of the detected ultrasound signal at each K^{th} period since the zero crossing after exceeding SW. Because A(K) is in both the numerator and denominator, variations in amplitude are normalized out, so if the time difference (t_1-t_0) is found to deviate because of a reduced or even increased signal amplitude, the invention as claimed detects same and makes a correction (which will be discussed in greater detail below when discussing the final rejections under §103(a)).

To support the final rejection of claims 1 and 4-7 under 35 USC §112, second paragraph, the final Office Action at paragraph 3 states that claims 1 and

7 (the independent claims) are considered to be vague and indefinite because they each include the equation

$$Ts \sim \left(\sum_{K=1}^{n} K * A(K) \right) / \sum_{K=1}^{n} A(K)$$

which includes undefined variables "K" and "A" making it unclear to one having ordinary skill in the art as to what the equation defines and how the equation is used in accordance with the remainder of the claim.

Appellant's Request For Reconsideration respectfully asserted that "K" is an integer in an integer range of 1 to "n," where "n" represents the highest integer value in said integer range and that "A(K)" is a function of K that is the amplitude of the K^{th} half-wave, after the threshold (trigger time) is exceeded. T_s is the chronological focal point of envelope curve 6, and that the skilled artisan would understand that the equation that T_s is a summation of "n" calculations of the equation's argument, taken at each consecutive integer value K=1, ... K=n.

In the Advisory Action dated February 17, 2010, which maintained the rejection on final, the Examiner repeated verbatim the final rejection. No analysis as to why the phrases used in the claim are vague and indefinite was offered in the response to appellant's Request For Reconsideration; MPEP 2173.02.

The Specification at page 4, lines 9-17, sets forth:

The time of the envelope curve focal point can be calculated, for example, in a processor unit according to the following equation:

$$T_s \sim \left(\sum_{K=1}^{n} K * A(K) \right) / \sum_{K=1}^{n} A(K)$$

where K is a running index that describes the number of positive half waves of the ultrasonic signal after the threshold is exceeded. A(K) is the amplitude of the K^{th} half-wave after the threshold (trigger time) is exceeded.

Appellant respectfully asserts that variables "K" and "A" used in the equation do not make it unclear to the skilled artisan as to "what the equation defines" and how the equation is used in accordance with the remainder of the claim.

The equation is the last element in the claims. For that matter, and with all due respect, the Examiner essentially agreed that the equation is readily understood in the Interview Summary mailed August 28, 2009, where he stated that

"a provisional agreement was reached that the combination of Eshita and Katakura does not teach determining a focal point if defined by the equation on page 4, line 13 of the specification."

Perhaps more importantly however, the test for definiteness under 35 USC §112, second paragraph, is whether those skilled in the art would understand what is claimed in light of the Specification; Orthokinetics, Inc. v. Safety Travel Chairs, Inc., 1 USPQ2d 1081, 1088 (Fed. Cir. 1986); MPEP 2173.02. Reference to the Specification makes clear what T_s is, and what the variables mean in the context of the invention, and appellant respectfully asserts

that the skilled artisan would understand the use of a summation, which is a common mathematical notation.

That is, the mathematical notation uses a summation symbol, the large upright capital Sigma ($\sum$) to compactly represent summation of many similar terms, as does the claimed equation for Ts. Wikipedia provides an explanation of several ways in which summations are known to be used, which appellant repeats here. For example:

$$\sum_{i=m}^{n} x_i = x_m + x_{m+1} + x_{m+2} + \ldots + x_{n-1} + x_n.$$

The subscript gives the symbol for an index variable, *i*. In the example, *i* represents the index of summation ("K" in T_s at issue herein); *m* is the lower bound of summation ("1" in T_s at issue herein), and n is the upper bound of summation ("n" in T_s at issue herein). Hence, *i* = *m* under the summation symbol means that the index *i* starts out equal to m (K = 1 in T_s at issue herein). Successive values of *i* are found by adding 1 to the previous value of *i*, stopping when *i* = *n* (K=n in T_s at issue herein).

The Wikipedia excerpt provides another example:

$$\sum_{k=2}^{6} k^2 = 2^2 + 3^2 + 4^2 + 5^2 + 6^2 = 90.$$

This example shows the index of summation, "K", squared for each K^{th} value to be summed. Informal writing sometimes omits the definition of the index and bounds of summation when these are clear from context, as in

$$\sum x_i^2 = \sum_{i=1}^{n} x_i^2.$$

One often sees generalizations of this notation in which an arbitrary logical condition is supplied, and the sum is intended to be taken over all values satisfying the condition. For example:

$$\sum_{0 \le k < 100} f(k)$$

is the sum of f(k) over all (integer) k in the specified range (like A(K) in T_s at issue herein).

Appellant respectfully asserts that the skilled artisan would readily understand the use of the summation notation, broadly.

In view of the Specification at page 4, lines 8-17, and at page 7, line 23 to page 8, line 9, the same skilled artisan would understand what the counter or index of summation "K" (variable), and what A(K) as the K^{th} half wave (variable) means in the equation Ts.

It follows that the variables "K" and "A(K)" are sufficiently defined, that one skilled artisan would understand how the equation Ts is used in accordance with the remainder of claims 1 and 7, and that claims 1 and 7 are neither vague nor indefinite under 35 USC §112, second paragraph.

2. Claims 1, 4, 6 and 7 are patentable under §103(a) over Eshita in view of Ai.

To support the final rejection of claims 1, 4, 6 and 7 over Eshita in view of Ai, the Examiner asserts that Eshita discloses an ultrasonic flow sensor (0014, lines 1-4), comprising at least one ultrasonic transducer for transmitting and receiving ultrasonic signals (0014, lines 1-4), and a receiver unit connected to the at least one ultrasonic transducer (0014, lines 4-12), that detects a predetermined event of the ultrasonic signal as a reception time (t_0), wherein the receiver unit determines a time (t_1) of a characteristic value of the ultrasonic signal (0026, lines 1-16) as well as a time shift (Δt) of the time (t_1) relative to the reception time (t_0) (0032, lines 1-13).

The Examiner then asserts that Eshita does not specify that the receiver unit determines a chronological position of a focal point of either the ultrasonic signal or its envelope curve as the characteristic value, and uses the uses the time shift (Δt) to determine a correct time value for the reception time (t_0).

The Examiner then asserts that Ai teaches a centroid approach for estimating modulation peak in a broad bandwidth interferometer comprising means for determining a chronological position (T_s) of a focal point of a signal

$$Ts \sim \left(\sum_{K=1}^{n} K * A(K) \right) / \sum_{K=1}^{n} A(K)\ .$$

at col. 7, lines 10-24, and that it would have been obvious to the skilled artisan to modify Eshita to determine a chronological position (T_s) of a focal point of either the ultrasonic signal or its envelope curve as the characteristic value, as taught by Ai, because Eshita explicitly discloses determining a time (t_1) of a characteristic value of the ultrasonic signal (0026, lines 1-16) and Ai suggests

corresponding means for determining a maximum location using an accurate and simple calculation that is effective when dealing with peaks that are difficult to distinguish (col. 3, line 55-col. 4, line 38; col. 7, lines 10-24).

While Appellant agrees that Eshita discloses determining a reception time of ultrasonic signals, and that Ai discloses identifying peaks of broad bandwidth interferometric signals, appellant respectfully disagrees with this analysis as a whole, and that either Eshita or Ai teach detecting a reception time (t_0), determining a time (t_1) of a characteristic value, determining a time shift (Δt) of the time (t_1) relative to the reception time (t_0) and using the time shift (Δt) to determine a correct time value for the reception time (t_0).

While the Examiner asserts that Eshita discloses a receiver unit that determines a time of a value characteristic of the ultrasonic signal at paragraph [0026], lines 1-16, paragraph [0026] merely teaches how Eshita calculates a reception time. Paragraph [0026] makes no suggestion of characteristic value of the ultrasonic signal, as claimed.

In more detail, Eshita's paragraph [0026] discloses that, after square wave (K) is counted, there is a wait or count of three more waves rising before the received signal is acknowledged. Nowhere does Eshita disclose determining a time **(t_1) of a characteristic value**, (emphasis added). Put another way, Eshita's operation of detecting the zero crossings is not equivalent to determining a time t_1 of the maximum amplitude as a reference point, as claimed.

Eshita's paragraph [0032] does not disclose using a time shift (Δt) of the time (t_1) of the characteristic value relative to the reception time (t_0) to determine

a correct time value for the reception time (t_0). Eshita merely subtracts a "predetermined" time from the time of flight calculation, so this "subtracting 'predetermined' time received wave (W) reaching timing also considering the time of the event of the supersonic wave being first received" disclosed by Eshita at paragraph [0032] cannot be said to be equivalent to the ***receiver determining*** a time shift (Δt) of the time (t_1) of the characteristic value of the ultrasonic signal relative to the reception time (t_0), as claimed (emphasis added).

While the Examiner asserts that Ai teaches a centroid approach to estimate modulation peak in broad bandwidth interferometer with means for determining a chronological position of a focal point of a signal T_s, and that it would have been obvious to modify Eshita with the teachings of Ai to realize a receiver unit that determines a chronological position of a focal point of the ultrasonic signal or its envelope as the characteristic value, appellant further respectfully disagrees.

At col. 7, lines 10-24, Ai discloses determining a peak (z) of bell-shaped curve f(z), and makes clear that any error or shift ("z will differ from the abscissa of its peak") in the peak resulting from naturally occurring asymmetry in f(z) as the interferometry data are captured, is consistently repeated but only as long as the data remain substantially unchanged. Col. 3, line 55-col. 4, line 19, merely talks about problems in the art with repeatability of modulation-peak estimation.

Ai in essence states that while the data remains unchanged, the error is always consistently reflected "perfectly" in the relative measure. Ai not only suggests operating with error, Ai does not mention operation where data is

inconsistent, that is, where there is fluctuating signal amplitude, the circumstances for which applicant's invention as claimed were meant to overcome.

So while the Examiner asserts that the skilled artisan would have looked to Ai to modify Eshita's receiver unit so the receiver unit could determine a chronological position of a focal point or either the ultrasonic signal or its envelope curve as the characteristic value, as taught by Ai, appellant disagrees. And while Ai teaches improving finding a peak, Eshita does not teach finding a peak or characteristic value, still less according to Ts.

But even if the references could be combined, Eshita could not be modified by the teachings of Ai without a substantial modification effort. Eshita does not determine a chronological position of a focal point of either the ultrasonic signal or its envelope curve as the characteristic curve, the time of the characteristic value and time shift (as stated above). To do so, Eshita's detectors and internal processor, for example, the instructions control overall operation, would need to be modified. While such a modification could be implemented, it is not a simple task and the skilled artisan would not have thought to do so.

Such proposed modification would render the Eshita unsatisfactory for its intended purpose (see In re Gordon, 221 USPQ 1125 (Fed. Cir. 1984)), and/or at least change Eshita's respective principles of operation (see In re Ratti, 123 USPQ 349 (CCPA 1959)), which in either case compels a legal conclusion that the proposed combinations cannot be obvious under the law; MPEP 2143.01.

Perhaps more importantly, appellant's invention is not merely a combination that includes finding a reception time, as taught by Eshita, and finding a peak, or improving the accuracy of finding a peak, as taught by Ai. Appellant claims finding a time t_1 of a characteristic value of a detected signal, calculating a time shift Δt of the time t_1 of the characteristic value of the ultrasonic signal relative to the reception time t_0, and using the time shift Δt to determine a correct time value for the reception time t_0. Hence, even modifying Eshita with the teachings of Ai still does not realize the invention, as claimed.

Claims 1, 4, 6 and 7, therefore, are not obvious under 35 USC §103(a) over Eshita in view of Ai.

3. Claims 1, 4, 6 and 7 are patentable under §103(a) over AAPA in view of Eshita further in view of Ai

In the final rejection, the Examiner argues with respect to claims 1 and 7 that AAPA comprises an ultrasonic flow sensor including at least one ultrasonic transducer for transmitting and receiving ultrasonic signals (page 1, lines 22-24 and 26-28; Fig. 6; page 5, lines 17) and a receiver unit that is connected to the ultrasonic transducer (page 6, line 30 to page 7, line 2) and detects a predetermined event of the ultrasonic signal at reception time (page 6, lines 29-30), wherein the receiver unit is embodied in such a way that it determines the time of a value characteristic of the ultrasonic signal (page 7, lines 4-6), that AAPA discloses determining a reception time as claimed, and a time value of a characteristic value of same ultrasonic signal.

The Examiner asserts that AAPA does not teach or suggest correcting the reception time by detecting a time shift between the reception time and time of the characteristic value.

The Examiner asserts that Eshita discloses an ultrasonic flow sensor (0014, lines 1-4), comprising at least one ultrasonic transducer for transmitting and receiving ultrasonic signals (0014, lines 1-4), and a receiver unit connected to the at least one ultrasonic transducer (0014, lines 4-12), that detects a predetermined event of the ultrasonic signal as a reception time (t_0) (0029, lines 1-4), wherein the receiver unit determines a time (t_1) of a characteristic value of the ultrasonic signal (0026, lines 1-16) as well as a time shift (Δt) of the time (t_1) relative to the reception time (t_0) (0032, lines 1-13).

The Examiner concludes that it would have been obvious to modify AAPA with Eshita to include Eshita's correcting the reception time as a function of the time shift of a characteristic value relative to the reception time because it would have improved AAPA by correcting for incorrect wave arrival timing to increase the precision of the arrival timing resulting in greater accuracy in flow determination of AAPA (0007, lines 2-15).

The Examiner further asserts that Eshita does not specify that the receiver unit determines a chronological position of a focal point of either the ultrasonic signal or its envelope curve as the characteristic value, and uses the uses the time shift (Δt) to determine a correct time value for the reception time (t_0), and that Ai teaches a centroid approach for estimating modulation peak in a

broad bandwidth interferometer comprising means for determining a chronological position (T_s) of a focal point of a signal

$$Ts \sim \left(\sum_{K=1}^{n} K * A(K) \right) / \sum_{K=1}^{n} A(K) \quad .$$

at col. 7, lines 10-24.

The Examiner then concludes that it would have been obvious to the skilled artisan to modify AAPA and Eshita to determine a chronological position (T_s) of a focal point of either the ultrasonic signal or its envelope curve as the characteristic value, as taught by Ai, because AAPA and Eshita explicitly discloses determining a time (t_1) of a characteristic value of the ultrasonic signal (AAPA, page 7, lines 4-6; Eshita 0026, lines 1-16; Fig. 2) and Ai suggests corresponding means for determining a maximum location using an accurate and simple calculation that is effective when dealing with peaks that are difficult to distinguish (col. 3, line 55-col. 4, line 38; col. 7, lines 10-24).

Appellants disagree with this analysis, and that it would have been obvious to have modified AAPA by what is disclosed by Eshita, and further modifying the combination by the teachings of Ai, to realize the invention, as claimed.

As stated above, Eshita does not discloses determining a time (t_1) of a characteristic value at paragraph [0026], or using a time shift (Δt) of the time (t_1) of the characteristic value relative to the reception time (t_0), as asserted by the Examiner in the last three lines of page 7 of the final Office Action. Nor does Eshita disclose determining a correct time value for the reception time (t_0), at

paragraph [0032], lines 1-13, as asserted by the Examiner in the last line of page 7, through the first two lines of page 8 of the final Office Action.

Also as stated above, incorporating the teachings of Ai into Eshita could not be carried out without substantially modifying Eshita because Eshita does not determine a chronological position of a focal point of either the ultrasonic signal or its envelope curve as the characteristic curve, the time of the characteristic value and time shift, and that such proposed modification would render the Eshita unsatisfactory for its intended purpose, and/or at least change Eshita's respective principles of operation.

Hence, it would not have been obvious to have modified AAPA in view of Eshita, and further modifying same with the teachings of Ai.

And in view of the shortcomings of Eshita, even assuming arguendo that the skilled artisan would have considered modifying AAPA by the teachings of Eshita and Ai, the proposed combination would still not realize a flow sensor that determines a time of a characteristic value of an ultrasound signal, a time shift of the time relative the reception time and uses the time shift to determine a correct time value of the reception time including determining a chronological position of a focal point of the ultrasonic signal or its envelope as the characteristic value, including the actual equation T_s, as claimed.

In view of the foregoing discussion, it is respectfully requested that the Honorable Board of Patent Appeals and Interferences overrule the final rejection of claims 1 and 4-7 under the second paragraph of section 112 and over the cited art, and hold that Appellant's claims be allowable over such art.

Respectfully Submitted,

Michael J. Striker
Attorney for Applicant
Reg. No.: 27233
103 East Neck Road
Huntington, New York 11743
631-549-4700

VIII. CLAIMS APPENDIX

Copy of Claims Involved in the Appeal:

1. An ultrasonic flow sensor, comprising

at least one ultrasonic transducer for transmitting and receiving ultrasonic signals, and

a receiver unit (4) connected to the at least one ultrasonic transducer that detects a predetermined event (N) of an ultrasonic signal as a reception time (t_0), wherein the receiver unit (4) determines a time (t_1) of a characteristic value of the ultrasonic signal as well as a time shift (Δt) of the time (t_1) relative to the reception time (t_0) and

uses the time shift (Δt) to determine a correct time value for the reception time (t_0), wherein the receiver unit (4) determines a chronological position (T_s) of a focal point of either the ultrasonic signal or its envelope curve (6) as the characteristic value, wherein

$$Ts \sim \left(\sum_{K=1}^{n} K * A(K) \right) / \sum_{K=1}^{n} A(K) .$$

2. (cancelled)

3. (cancelled)

4. The ultrasonic flow sensor as recited in claim 1,

wherein the receiver unit (4) includes a comparator (10) comprising inputs that are respectively supplied with a transducer output signal (5) and a reference signal (SW), and the receiver unit (4) determines a piece of information about the time (t_1) of the characteristic value from an output signal of the comparator (10).

5. The ultrasonic flow sensor as recited in claim 4, wherein the reference signal supplied to the comparator (10) is a threshold (SW) not equal to zero and the output signal of the comparator (10) is a pulse width modulated signal (K1) from which the time (t_1) of the characteristic value is determined.

6. The ultrasonic flow sensor as recited in claim 1, wherein the reception time (t_0) is corrected as a function of the time shift (Δt).

7. A method for detection of an ultrasonic signal in an ultrasonic transducer by means of a receiver unit (4), which detects a predetermined event (N) of the ultrasonic signal as a reception time (t_0), wherein the receiver unit (4) determines a time (t_1) of a characteristic value of the ultrasonic signal and determines a time shift (Δt) of the time (t_1) in relation to the reception time (t_0) and uses the time shift (Δt) to determine a correct time value for the reception time (t_0), wherein the receiver unit (4) determines a chronological position (T_s) of a focal point of the ultrasonic signal or its envelope curve (6) as the characteristic value, wherein

$$Ts \sim \left(\sum_{K=1}^{n} K * A(K) \right) / \sum_{K=1}^{n} A(K) .$$

8. (cancelled)

9. (cancelled)

IX. EVIDENCE APPENDIX.

Three (3) page excerpt from "Wikipedia" on Summation.

Summation

From Wikipedia, the free encyclopedia

Summation is the operation of combining a sequence of numbers using addition; the result is their **sum** or *total*. An interim or present total of a summation process is termed the *running total*. The numbers to be summed may be integers, rational numbers, real numbers, or complex numbers, and other types of values than numbers can be added as well: vectors, matrices, polynomials, and in general elements of any additive group (or even monoid). For finite sequences of such elements, summation always produces a well-defined sum (possibly by virtue of the convention for empty sums).

Summation of an infinite sequence of values is not always possible, and when a value can be given for an infinite summation, this involves more than just the addition operation, namely also the notion of a limit. Such infinite summations are known as series. Another notion involving limits of finite sums is integration. The term summation has a special meaning related to extrapolation in the context of divergent series.

The summation of the sequence [1, 2, 4, 2] is an expression whose value, the sum of the sequence, is defined to be that of the repeated addition 1 + 2 + 4 + 2, namely 9. Since addition is associative the value does not depend on how the additions are grouped, for instance (1 + 2) + (4 + 2) and 1 + ((2 + 4) + 2) both have the value 9; therefore parentheses are usually omitted in repeated additions. Addition is also commutative, so permuting the terms of a finite sequence does not change its sum. (For infinite summations this property may fail; see absolute convergence for conditions under which it still holds.)

There is no special notation for summation of such explicitly given sequences, as the corresponding repeated addition expression will do (but such an expression does not exist for the summation of an empty sequence; one may substitute "0" for such a summation). If however the terms of the sequence are given by regular pattern, possibly of variable length, then use of a summation operator may be useful or even essential. For the summation of the sequence of consecutive integers from 1 to 100 one could use an addition expression involving an ellipsis to mark out the missing terms: 1 + 2 + 3 + ... + 99 + 100. In this case the reader easily guesses the pattern; however for more complicated patterns, one needs to be precise about the rule used to find successive terms, which can be achieved by using the summation operator "Σ". Using this notation the above summation is written

$$\sum_{i=1}^{100} i.$$

The value of this summation is 5050. It can be found without performing 99 additions, since it can be shown (for instance by mathematical induction) that

$$\sum_{i=1}^{n} i = \frac{n^2 + n}{2}$$

for all natural numbers n. More generally, formulas exist for many summations of terms following a regular pattern.

The term "indefinite summation" refers to the search for an inverse image of a given infinite sequence s

of values for the forward difference operator, in other words for a sequence, called antidifference of s, whose finite differences are given by s. By contrast, summation as discussed in this article is called "definite summation".

Contents

Capital-sigma notation

Mathematical notation uses a symbol that compactly represents summation of many similar terms: the *summation symbol* $\sum$ (U+2211), a large upright capital Sigma. This is defined thus:

$$\sum_{i=m}^{n} x_i = x_m + x_{m+1} + x_{m+2} + \dots + x_{n-1} + x_n.$$

The subscript gives the symbol for an index variable, i. Here, i represents the **index of summation**; m is the **lower bound of summation**, and n is the **upper bound of summation**. Here $i = m$ under the summation symbol means that the index i starts out equal to m. Successive values of i are found by adding 1 to the previous value of i, stopping when $i = n$. An example:

$$\sum_{k=2}^{6} k^2 = 2^2 + 3^2 + 4^2 + 5^2 + 6^2 = 90.$$

Informal writing sometimes omits the definition of the index and bounds of summation when these are clear from context, as in

$$\sum x_i^2 = \sum_{i=1}^{n} x_i^2.$$

One often sees generalizations of this notation in which an arbitrary logical condition is supplied, and the sum is intended to be taken over all values satisfying the condition. For example:

- $$\sum_{0\le k<100} f(k)$$

is the sum of $f(k)$ over all (integer) k in the specified range,

$$\sum_{x\in S} f(x)$$

is the sum of $f(x)$ over all elements x in the set S, and

$$\sum_{d|n} \mu(d)$$

is the sum of $\mu(d)$ over all integers d dividing n.[1]

There are also ways to generalize the use of many sigma signs. For example,

$$\sum_{\ell,\ell'}$$

is the same as

$$\sum_{\ell}\sum_{\ell'}.$$

A similar notation is applied when it comes to finding multiplicative products; the same basic structure is used, with $\prod$, or the capital pi, replacing the $\sum$.

Programming language notation

Summations can also be represented in a programming language. Some languages use a notation for summation similar to the mathematical one. For example, this is Python:

```
sum(x[m:n+1])
```

and this is the Perl equivalent of the above Python:

```
use List::Util 'sum';
sum($m..$n);
```

and this is the PHP equivalent of the above Python:

```
$sum = array_sum($x);
```

X. RELATED PROCEEDINGS APPENDIX.

None.